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THE EFFECT OF THE APPLICATION OF WATER-RETAINING GRANULES AKVOD ON THE CABBAGE BROCCOLI YIELD CAPACITY IN CONDITIONS OF A FOREST-STEPPE ZONE OF UKRAINE

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The investigation results of the effectiveness of water-retaining granules Akvod in conditions of growing seedlings of cabbage broccoli as well as their influence on yield capacity of plants in conditions of a forest-steppe zone of Ukraine are presented in the article.

Key words: Seedlings, cabbage broccoli, water-retaining granules Akvod, yield capacity.

Human activity requires the increasing usage of resources, among which water is the most valuable. Modern agriculture consumes almost two thirds of water, used all over the world. Therefore more and more attention is paid to searching the ways of water saving. Solving of this problem depends to some extent on the investigation and introduction of new technological methods and elements that promote rational usage of water resources. Super absorbents occupy here a significant niche. Akvod is a super absorbent added to the soil or soil mixture; it can absorb as well as keep large amount of water and nutrients. Unlike great number of moisture absorbing substances, Akvod has the quality to give the absorbed moisture and nutrients to plants easily. In the result of this absorbent's application, the number of irrigations on the irrigated land cuts to 50%, moisture evaporation and loss of nutrients from soil reduce, plant growth improves as water and nutrients are constantly available for its root system.

Akvod consists of polyacrylamide anions which are insoluble in water, sewn polymers of acrylamide and acrylate of potassium, able to absorb 500 times more distilled water than it weighs turning into gel. Polymers contain a range of parallel polymer chains creating a net [1].The preparation gives rise to the productivity of plants, intensifies their flowering; as for hydro gel it helps plants to survive even in the heat and is a good alternative to drip irrigation [2].

Plants are depressed by the lack of precipitation and soil moisture deficit. Irrigation during the vegetation period can prevent the death of plants, though not all the water entering the soil is available to plants. Most of it evaporates and penetrates into the soil layer inaccessible for the root system of plants. To avoid water losses, absorbents-hydro gels are added into the soil [3]; they considerably improve provision of plants with moisture and nutrients especially if they are brought in with the addition of water. In this case the risk of burning the root system with fertilizers is minimized. Hydro gel lets the plant get water, and is able to absorb its remains in conditions of the excessive irrigation, creating an optimal regime of plant water supply, to exclude the problem of 'overwatering' [4].

The aim of the investigation is to study the influence of the application of different doses of water retaining granules Akvod while growing cabbage broccoli on capacity and quality of yield.

Investigation methods. The investigation was carried out in 2010-2011 in conditions of Ukrainian Forest steppe zone on the experimental field of VNAU. Cabbage broccoli was grown from seedlings with the application of different norms of water retaining granules Akvod. The soil on the experimental field is grey forest, medium loamy, with humus content of 2,4 %, with pH of 5.8, P_2O_5 – 21,2 mg, K_2O – 9,2 mg per 100 g of soil. Cabbage broccoli of Lednitska variety was grown in seedlings. Seedlings were grown in cassettes 6×6 in size in hotbeds under the generally accepted growing technology.

During the experiments the application of hydro gel Akvod granules has been studied. 10, 20, 30, 40 grams of granules per 10 kilograms of soil mixture were added. Granules were not applied in the test variant. Seedlings of 60 days

were planted in the prepared soil according to the regional recommendations in the first decade of April by the scheme 70×30 sm. The experiment was repeated four times. Area of the accounted plot was 20m². The technology of plant growing was generally accepted for the Forest-steppe zone of Ukraine. For all that phenological observations, biometric measurements and accounting are provided [5]. Harvesting was carried out in accordance with the current standard depending on the forming of heads – "Fresh cabbage broccoli – RST USSR 1483-89" [6]. By biometric processing of results of the investigation computer programs were used.

Investigation results. In the process of growing seedlings at different norms of application of water-retaining granules or without them, much difference in coming of phenological phases wasn't revealed. While planting out seedlings, it has been observed that the variants differed in height: with the addition of 20 g of granules per 10 kg of soil mixture (22,8 cm), 30 g – 23,3 cm and 40 g – 23,8 cm, which is by 11,2 %, 13,7 % and 16,1 % more compared with the control – 20,5 cm, (table 1). During the period of planting out seedlings there has also been pointed out that variants with the application of water-retaining granules had larger amount of leaves compared with control variant: 20g per 10 kg of soil mixture – 6,6 leaves, 30 g – 6,7 leaves, and 40 g – 6,8 leaves, which is accordingly by 11,9%, 13,6 %, and 15,3 % more compared with the control – 5,9 leaves. Direct connection between the seedling height and the amount of leaves on the plant has been determined (r = 0,99). Stem thickness of plants within this period in variants with the dose of granule application 30 g per 10 kg of soil mixture was 4,6 mm, 40 g – 4,7 mm, which is accordingly by 18,0 %, and 20,5 % more compared with the control – 3,9 mm. Plants with the application of water-retaining granules had larger leaf surface area compared with the control variant (20, 30, 40 g per 10 kg of soil mixture, by 21,8 %, 25,9 %, and 28,3 % more). It has been determined by analysis that there is a strong direct connection between the leaf surface area and the amount of leaves (r=0,99)

1. Biometric and phytometric features of cassette seedlings of cabbage broccoli under its planting out depending on the norm of application of water-retaining granules *Akvod* (average for 2010-2011)

Granule dose per 10 kg of soil mixture	Height of the plant, cm	Leaves number	Stem thickness, mm	Leaf surfvace area, cm^2/plant
Without granule application (control)	20,5	5,9	3,9	221,6
10 g	20,9	6,1	4,1	235,2
20 g	22,8	6,6	4,5	269,9
30 g	23,3	6,7	4,6	278,9
40 g	23,8	6,8	4,7	284,3

Thus, water-retaining granules Akvod depending on the dose of its application influence the biometric and phytometric indicators of seedlings of cabbage broccoli.

When applying 30 and 40 g of water-retaining granules per 10 kg of soil mixture the head formation of cabbage broccoli is 2 days earlier – 29.05, than at control (31.05). The interphase period of head formation – technical maturity of plants of cabbage broccoli with the addition of 20, 30, and 40 g of water-retaining granules per 10 kg of soil mixture was by one day shorter compared with the control variant. Duration of the inflow of the cabbage broccoli yield was largely influenced both by the application of granules and weather conditions in the period of crop ripening. In variants with the application of water-retaining granules the inflow of production lasted for 35-37 days, at the control – 38 days that is 1-3 days longer.

Thus, application of water-retaining granules moderately affects the phase coming as well as the duration of interphase periods of cabbage broccoli plants. The highest during the phase of technical maturity were the plants with the application of 40 g of water-retaining granules per 10 kg of soil mixture – 43,9 cm, which is 9,5 % more compared with the control variant – 40,1 cm, (table 2).Under

these conditions the stems of plants are thicker with the application of 30 g of water-retaining granules per 10 kg of soil mixture – 15,4 mm, 40 g – 15,7 mm, which is by 0,9 and 1,2 mm more compared with the control variant – 14,5 mm.

2. Biometric and physiological features of plants of cabbage broccoli in the phase of technical maturity of cabbage heads depending on the application dose of water-retaining granules (average for 2010-2011)

Granule dose per 10 kg of soil mixture (control)	Height of the plant, cm	Number of leaves	Stem thickness, mm	Rosette diameter, cm	Leaf surface area m^2/ha	Net productivity of photosynthesis g/m^2 per day
Without application of granules	40,1	11,4	14,5	48,3	23,7	7,8
10 g	40,9	11,7	14,8	49,2	24,6	8,0
20 g	42,2	12,1	15,0	52,5	26,4	8,3
30 g	43,1	12,3	15,4	53,6	27,0	8,5
40 g	43,9	12,5	15,7	55,1	27,2	8,6

Strong direct connection between the height of the plant and the stem thickness was determined by analysis (r=0,99). In this period the diameter of a rosette of plant's leaves in variants with the application rate of water-retaining granules 20g per 10 kg of soil mixture was 52,5 cm, 30 g – 53,6 cm and 40 g – 55,1 cm, which is by 8,7, 11,0 and 14,1 % more compared with the control – 48,3 cm. The biggest amount of leaves had the variants where 40 g of water-retaining granules per 10 kg of soil mixture were applied – 12,5 leaves/plant, which is by 9,7 % more compared with the control – 11,4 leaves per plant. Strong direct connection between the number of leaves on the plant and the stem thickness as well as between the number of leaves and rosette diameter of leaves was determined by analysis (r=0,99).

One of the most important indicators that characterize the general state of plants is area of their assimilated surface which under the application of 20 g of water-retaining granules per10 kg of soil mixture was 26.4 thousand $m^{2/}$ ha, 30 g – 27,0 thousand m^2/ha and 40 g – 27,2 thousand m^2/ha, which is by 11,4, 13,9 and 14,8 % more compared with the control – 23,7 thousand m^2/ha. Strong direct connection between the leaf surface area and the number of leaves on the plant was determined by analysis (r=0,99). Strong direct connection between the diameter of the rosette and the leaf surface area was also determined (r=0,99). In variants with the application rate of water-retaining granules 20-40 g per 10 kg of soil mixture net productivity was 8,3-8,6 g/m^2per day, at control – 7,8 g/m^2per day, which is by 6,4-10,3 % less. Strong direct connection between the net productivity of photosynthesis and the leaf surface area as well as between the number of leaves on the plant and the net productivity of photosynthesis was marked (r=0,99).

Thus, water-retaining granules Akvod influence the biometric and physiological features of cabbage plants at all stages of its growth and development.

The highest yield capacity was obtained with the application of 20 g of water-retaining granules per 10 kg of soil mixture – 16,2 t/ha, 30 g – 16,6 t/ha, 40 g – 16,8 t/ha, which is accordingly by 1,7; 2,1 and 2,3 t/ha more compared with the control – 14,5 t/ha (table 3). The essentiality of this differencewas proved by the results of the dispersive analysis within two years of scientific research. It should be noted that the increase of yield compared with the control depended directly on the applied dose of water-retaining granules. In accordance with the results of the investigation increase of the application dose of granules from 20 to 40 g per 10 kg of soil mixture led to the yield increase from 0,4 to 2,3 t/ha or by 2,6 – 15,6 %. Strong direct connection between the leaf surface area and the number of leaves on the plant was determined by analysis (r=0,99). Strong direct connection between the indicator of yield capacity and the net productivity of photosynthesis as well as between yield capacity and leaf surface area of cabbage broccoli was also determined (r=0,99).

3. Cabbage broccoli yield capacity depending on the application rate of water-retaining granules, t/ha

Dose of granules per 10 kg of soil mixture	Year		Average	Yield increasecompared with the control	
	2010	2011		t/ha	%
Without application of granules (control)	13,5	15,5	14,5	–	–
10 g	13,9	15,9	14,9	+0,4	2,6
20 g	15,2	17,3	16,2	+1,7	11,6
30 g	15,5	17,8	16,6	+2,1	14,4
40 g	15,6	17,9	16,8	+2,3	15,6
HIP_{05}	0,7	1,3	–		

The weight of the central head with the application dose 20 g of water-retaining granules per 10 kg of soil mixture – 199 g, 30 g – 201 g and 40 g – 202 g, which is by 10,0 %, 11,1 % and 11,2 % more compared with the control (table 4). However the increase in the dose of granules' application didn't influence greatly the weight of the central head. Strong direct connection between the weight of the central head andyield capacity, the net productivity of photosynthesis, and also leaf surface area of cabbage broccoli was determined (r=0,99).

The total weight of lateral heads with the application of 30 g of water-retaining granules per 10 kg of soil mixture was equal to 237 g, 40 g – 238 g, which is accordingly by 12,9 and 13,3 % more compared with the control – 210 g. Strong direct connection between the weight of the lateral heads andnet productivity of photosynthesis (r=0,96), and also leaf surface area of cabbage broccoli (r=0,98), between the weight of the central head and the weight of lateral heads (r=0,93) was determined (r=0,99). The significant difference in the diameter of the central head was determined in all variants with the application of water-retaining granules Akvod compared with control. Strong direct connection between the weight of the central head andits diameter (r=0,99). The largest number of marketable products was obtained with the application of 30 g of water-retaining

granules per 10 kg of soil mixture – 87,9 %, and 40 g – 88,8 %, which is accordingly by 2,9 and 3,8 % more compared with the control – 85,0 %.

4. Qualitative indicators of marketable yield of cabbage broccoli depending on the application rates of water-retaining granules

Granule dose, per 10 kg ofsoil mixture	Weight of marketable yield , g/plant		Diameter of central head, cm	Marketability of yield, %
	of central head	total of lateral heads		
Without application of granules (control)	110	196	8,4	85,0
10 g	118	196	9,3	85,9
20 g	125	216	9,7	86,2
30 g	130	219	10,0	87,9
40 g	133	220	10,2	88,8

Strong direct connection between the yield capacity and marketability (r=0,90), between the net productivity of photosynthesis and the percentage of marketable yield (r=0,95) was determined by analysis.

Conclusions

Application of water-retaining granules Akvod affects the coming of phenological phases, duration of interphase periods, biometric and physiological features of plants of cabbage broccoli. The highest yield of production was obtained with the dose application of 20 g of water-retaining granules per 10 kg of soil mixture – 16,2 t/ha, 30 g – 16,6 t/ha, 40 g – 16,8 t/ha, which is accordingly by 1,7; 2,1 and 2,3 t/ha more compared with the control – 14,5 t/ha. The essentiality of this differencewas proved by the results of the dispersive analysis within two years of scientific research. The yield increase compared with the control variant depends directly on the dose of water-retaining granules. The significant influence of doses of water-retaining granules on the dynamics of yield increase was found out.

REFERENCES

1. О гидрогеле [Електронний ресурс] // Режим доступу: http://www. glicdizain.com.ua/txt-1.html.

2. Гідрогель AQUASORB [Електронний ресурс] // Режим доступу: http://www. gidrogel.org.

3. Гидрогель LUXSORB™ - влагоудерживающий суперабсорбент [Електронний ресурс] – Режим доступу: // www.agro-technology.narod.ru/ - 96k.

4. Гидрогель в растениеводстве [Електронний ресурс] – Режим доступу: // www. avroragro.ru

5. Методика дослідної справи в овочівництві і баштанництві / За редакцією Г.Л. Бондаренка, К.І. Яковенка. – Харків.: Основа, 2001. – 369 с.

6. РСТ УССР 1483-89 Капуста брокколи свежая. Технические условия: Введен. 1.01.91.-К: изд. официальное, 1990.- 6 с.

ВПЛИВ ЗАСТОСУВАННЯ ВОДОУТРИМНИХ ГРАНУЛ АКВОД НА ВРОЖАЙНІСТЬ КАПУСТИ БРОКОЛІ В УМОВАХ ЛІСОСТЕПУ УКРАЇНИ

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Наведено результати досліджень ефективності застосування водоутримуючих гранул аквод при вирощуванні розсади капусти броколі та їх вплив на урожайність рослин в умовах Лісостепу України.

Ключові слова: *розсада, капуста броколі, водоутримні гранули аквод, урожайність.*

ВЛИЯНИЕ ПРИМЕНЕНИЯ ВОДОУДЕРЖИВАЮЩИХ ГРАНУЛ АКВОД НА УРОЖАЙНОСТЬ КАПУСТІ БРОККОЛИ В УСЛОВИЯХ ЛЕСОСТЕПИ УКРАИНЫ

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В условиях Лесостепи Украины проведены исследования по применению разных доз водоудерживающих гранул гидрогеля Аквод при выращивании рассады в кассетах на урожайность капусты брокколи. Установлено, что наибольшую урожайность капусты брокколи получено в вариантах с нормой применения водоудерживающих гранул 20 г на 10 кг почвенной смеси – 16,2 т/га, 30 г – 16,6 т/га, 40 г – 16,8 т/га, что на 1,7, 2,1 та 2,3 т/га больше чем в контроле – 14,5 т/га. Применение гранул гидрогеля способствует повышению качества продукции капусты брокколи.

Ключевые слова: *рассада, капуста брокколи, водоудерживающие гранулы акводу урожайность*